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PALEONTOLOGY.—*The larger Foraminifera of the Talara shale of northwestern Peru.*¹ WILLARD BERRY, Ohio State University.
(Communicated by EDWARD W. BERRY.)

In 1928 I described the smaller Foraminifera of the middle Lobitos shales of northwestern Peru.² In the same year this formation was named Saman shales by Iddings and Olsson.³ Again in 1930 Olsson changed the name from Saman to Talara shale⁴ and correlated it with the Bartonian as I did in 1928.

In my discussion of the smaller Foraminifera I mention the occurrence of *Lepidocyclina*- and *Operculina*-bearing grits or sandstone about 958 feet above the base of the Talara shales (Saman shales). These grits which are only several feet thick are yellow-brown calcareous sandstones with subangular grains up to 1.5 mm. in diameter. These grains are mostly clear quartz with occasional dark ferruginous grains, apparently limonite. What heavy minerals may be present is unknown as no separation has been made. These grits are thin bedded and tend to weather to light-colored sand. The beds are very sparsely fossiliferous and the described forms were obtained by prolonged and careful collecting along the strike of the rocks.

The faunule consists of seven species of *Lepidocyclina* and three species of *Operculina*. In this faunule the species of *Lepidocyclina* do

¹ Received October 31, 1931. Work carried out under a grant-in-aid, National Research Council.

² *Eclogae Geol. Helvetiae* 21 (2): 390-405. 1928.

³ Iddings and Olsson. *The geology of northwest Peru*. Bull. Am. Asso. Pet. Geol. 12 (1): 1928.

⁴ A. A. Olsson. *Eocene Mollusca*. Bull. Am. Paleon. 17 (62): 1930.

not seem to be closely related to any described forms with the exception of the one species of the subgenus *Helicolepidina* which is very close to *Lepidocyclina* (*Helicolepidina*) *spiralis* Tobler from the Priabonian of San Fernando, Trinidad, and Río San Pedro, Venezuela. There is apparently no relation between these forms and the small fauna from the basal portion of the same formation (Saman conglomerate) as described from the Atascadero limestone exposed about 22 miles northeast of this locality. There is a slight similarity between these forms and the as yet undescribed forms from the Talara sandstones (Saman sandstones) collected north of Lagunitos. The similarity between this faunule and the fauna of the Verdun grits (which Olsson now refers to the Eocene) lies in the marked absence of microspheric forms. None have been found in this collection and only about 4 per cent in the Verdun fauna.

The *Operculina* on the other hand bear a closer relation to those of the Atascadero forms, as one is clearly a variety of *Operculina atascaderensis* W. Berry, described from the Atascadero limestone. The other two are new to science.

The exact conditions under which this thin bed of sandstone was laid down are indefinite. Apparently it is a local feature as it is not found everywhere that the Talara shales are exposed. From the coarse subangular character of the sand grains and the lack of microspheric forms sedimentation must have been very rapid. The forms are all thought to be typical of shallow, warm, or tropical waters and the shales both below and above the bed contain forms characteristic of deeper and cooler waters. From what direction these coarse sediments were washed into the sea is undecided due to the limited extent of the bed. From general appearance it is quite like the matrix of the Verdun grits which are supposed to have come from the southwest. It is quite apparent, however, that during the deposition of the Talara shales there was a period of fairly sudden rise and then sudden deepening of the sea in this region as the shales do not grade into the sands or the sands grade into the shales, the boundaries being very clearly marked. Another possibility is that for some reason the run-off was especially rapid at this point for a short time and much sand was washed into the sea. It is entirely possible that somewhere along the then existing shore the forms from the basal portion of the formation were developing and that they gave rise to this endemic faunule which is to be described. The places where the evolution was going on have either been destroyed by subsequent erosion before the sandstone was deposited or else have not yet been discovered.

Genus LEPIDOCYCLINA.

Subgenus LEPIDOCYCLINA SS.

Lepidocyclus samanica W. Berry n.sp.

Figure 10.

Test discoidal, equilateral, small, thin, 2.4 mm. in diameter, 0.75 mm. thick, ratio of diameter to thickness 3.3:1. Test thins more or less evenly from the center to the periphery, with no flange. Surface papillated, small and fairly evenly spaced. Pillars polygonal in shape and 83.5 microns in diameter at the surface. The lateral chambers at the surface are 116.9 microns in diameter with walls 16.7 microns thick.

The nucleoconch is composed of two subequal chambers separated by a thin straight wall. The width of the nucleoconch is 218.4 microns and the length is 312 microns, the ratio of the length to the width is 1.4:1, with walls 35.1 microns thick. The equatorial chambers are arcuate and are arranged in circles; these chambers are 35.1 microns in radial diameter and 31.2 microns in tangential diameter, with walls 19.5 microns thick.

Cotypes.—Collection of Willard Berry No. L-22.

Occurrence.—Talara shale 958 feet above base; northwestern Peru.

L. samanica, which is next to the largest *Lepidocyclus* in this sandstone does not seem to be related to any described form and can easily be recognized by its large size and the ratio of the length to the width of the nucleoconch.

Lepidocyclus sectionensis W. Berry n.sp.

Fig. 11.

Test discoidal, equilateral, small, thin, 1.83 mm. in diameter, 0.45 mm. thick, ratio of diameter to thickness 4:1. Test thins evenly from the center to the periphery, with no flange. Surface reticulate, sparingly papillated. Pillars polygonal in shape and 66.8 microns in diameter at the surface. The lateral chambers at the surface are 100.2 microns in diameter with walls 16.7 microns thick.

The nucleoconch is composed of two subequal chambers separated by a thin straight wall. The width of the nucleoconch is 257.4 microns and the length 390 microns, the ratio of the length to the width is 1.5:1, the walls are 31.2 microns thick. The equatorial chambers are arranged in circles, these chambers are 39 microns in radial diameter and 42.9 microns in tangential diameter, with walls 23.4 microns thick.

Cotypes.—Collection of Willard Berry No. L-18.

Occurrence.—Talara shale, 958 feet above base. Northwestern Peru.

L. sectionensis has a rather characteristic arrangement of chambers around the nucleoconch. On one side are 3 relatively large secondary chambers and on the other side 2. This arrangement is nearest to *L. seis* and *L. ocha* from the same locality but these two have 3 large secondary chambers on each side of the nucleoconch, but differ in other respects. *L. sectionensis* is the thinnest form from this locality.

Lepidocyclina ocha W. Berry n.sp.

Fig. 4.

Test discoidal, equilateral, small, thin 1.67 mm. in diameter and 0.71 mm. thick, ratio of diameter to thickness 2.3:1. Test thins evenly from the center to the periphery, with no flange. Surface papillated, small and evenly spaced. Pillars polygonal in shape and 50.1 microns in diameter at the surface. The lateral chambers at the surface are 83.5 microns in diameter with walls 15 microns thick.

The nucleoconch is composed of two subequal chambers separated by a thin straight wall. The width of the nucleoconch is 195 microns and the length is 273.3 microns, the ratio of the length to the width is 1.4:1, with walls 19.5 microns thick. The equatorial chambers are arcuate-rhombic and are arranged in circles; these chambers are 39 microns in radial diameter and 31.2 microns in tangential diameter with walls 19.5 microns thick.

Cotypes.—Collection of Willard Berry No. L-19.

Occurrence.—Talara shale, 958 feet above base; northwestern Peru.

L. ocha is like *L. seis* and *L. ariena* in having 3 relatively large secondary chambers on both sides of the nucleoconch. In ratio of length to width of the nucleoconch it is like *L. samanica* but differs in all other respects. It is easily recognized in thin section by the 3 secondary chambers on each side of the nucleoconch and the heaviness of the equatorial chamber walls.

Lepidocyclina gritta W. Berry n.sp.

Fig. 9.

Test discoidal, equilateral, small, thin, 2.08 mm. in diameter, 0.60 mm. thick, ratio of diameter to thickness 3.4+:1. Test thins evenly from the center to the periphery, with no flange. Surface papillated, small, and evenly spaced. Pillars polygonal in shape and 50.1 microns in diameter at the surface. The lateral chambers at the surface are 83.5 microns in diameter with walls 16 microns thick.

The nucleoconch is composed of two subequal chambers separated by a thin, straight wall. The width of the nucleoconch is 292.8 microns and the length is 331.5 microns, the ratio of the length to the width is 1.13+:1, with walls 27.3 microns thick. The equatorial chambers are arcuate to hexagonal and are arranged part in circles and part in columns; these chambers are 58.5 microns in radial diameter and 58 microns in tangential diameter with walls 17 microns thick.

Cotypes.—Collection of Willard Berry No. L-20.

Occurrence.—Talara shale, 958 feet above base; northwestern Peru.

L. gritta can be easily recognized in thin section by the way the equatorial chambers are first arcuate and in circles, then hexagonal and arranged in columns and then arcuate and in circles. It is entirely unlike any described form.

Lepidocyclina ariena W. Berry n.sp.

Fig. 6

Test discoidal, equilateral, small, thin, 1.70 mm. in diameter, 0.62 mm. thick, ratio of diameter to thickness $2.7+ : 1$. Test thins evenly from the center to the periphery, with no flange. Surface papillated, very noticeable, and fairly evenly spaced. Pillars polygonal in shape and 83 microns in diameter at the surface. The lateral chambers at the surface are 133.6 microns in diameter with walls 33.4 microns thick.

The nucleoconch is composed of two subequal chambers separated by a thin straight wall. The width of the nucleoconch is 245.7 microns and the length is 351 microns, the ratio of the length to the width is $1.42+ : 1$, with walls 31.2 microns thick. The equatorial chambers are open-arcuate and are arranged in circles: these chambers are 31.2 microns in radial diameter and 27.3 microns in tangential diameter with walls 23.4 microns thick.

Cotypes.—Collection of Willard Berry No. L-21.

Occurrence.—Talara shale, 958 feet above base; northwestern Peru.

L. ariena is like *L. ocha* and *L. seis* in having 3 relatively large secondary chambers on either side of the nucleoconch but differs in all other respects. It is the smallest *Lepidocyclina* found in the formation and can easily be recognized by the smallness of the equatorial chambers.

Lepidocyclina seis W. Berry n.sp.

Fig. 3.

Test discoidal, irregularly equilateral, fairly large, thin, 3.34 mm. in diameter, 1.5 mm. thick, ratio of diameter to thickness $2.2+ : 1$. Test thins evenly to within 0.4 mm. of the periphery, where there is a narrow flange; diameter of central boss 2.54 mm. Surface papillated, fairly large and slightly more numerous on the boss, otherwise evenly spaced. Pillars polygonal, 133.6 microns in diameter at the surface. The lateral chambers at the surface are 50.1 microns in diameter with walls 20 microns thick.

The nucleoconch is composed of two subequal chambers separated by a thin straight wall. The width of the nucleoconch is 249.6 microns and the length is 347.1 microns, the ratio of length to the width is $1.39- : 1$, with walls 27.3 microns thick. The equatorial chambers are arcuate-hexagonal and are arranged in circles to columns; these chambers are 39 microns in radial diameter and 42.7 microns in tangential diameter with walls 13.7 microns thick.

Cotypes.—Collection of Willard Berry No. L-24.

Occurrence.—Talara shale, 958 feet above base; northwestern Peru.

L. seis is very characteristic in thin section as the equatorial chambers are first arranged in circles but about half way to the periphery they are arranged in columns. See *L. ariena* and *L. ocha* for comparison with those species.

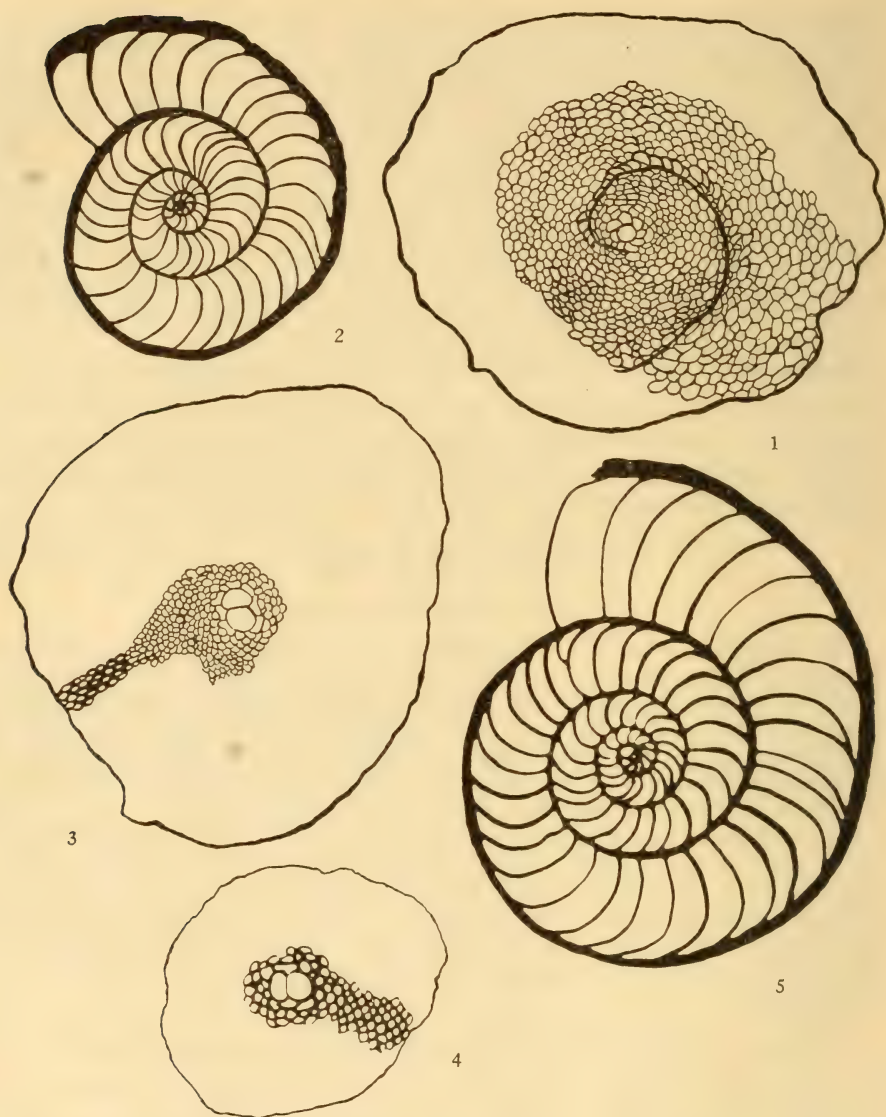


Fig. 1—*Lepidocyclina* (*Helicolepidina*) *august-tobleri* n. sp. $\times 20$.

Fig. 2—*Operculina samanica* n. sp. $\times 20$.

Fig. 3—*Lepidocyclina seis* n. sp. $\times 20$.

Fig. 4—*Lepidocyclina ocha* n. sp. $\times 30$.

Fig. 5—*Operculina atascaderensis* var. *samanica* n. var. $\times 20$.

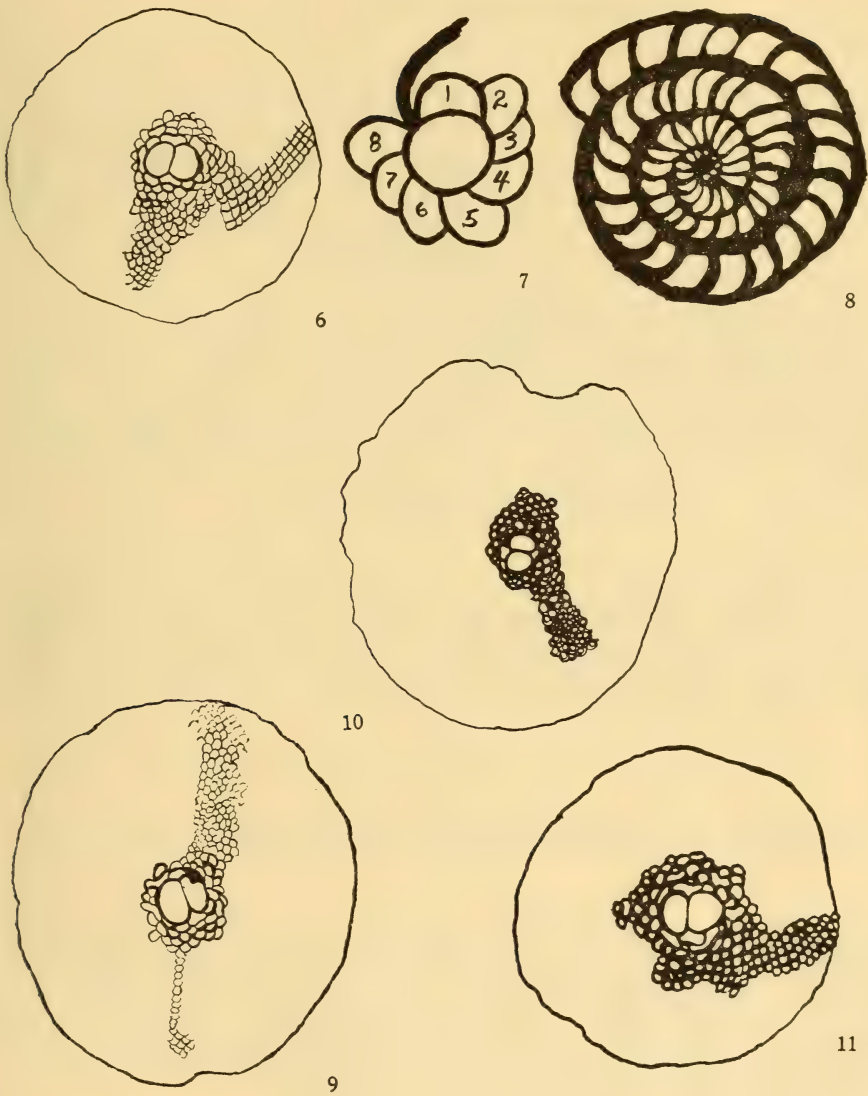


Fig. 6—*Lepidocyclina ariena* n. sp. $\times 25$.

Fig. 7.—Nucleoconch *H. august-tobleri* $\times 64$; Chambers 1-8 are primarily spiral chambers.

Fig. 8—*Operculina talara* n. sp. $\times 25$.

Fig. 9—*Lepidocyclina gritta* n. sp. $\times 25$.

Fig. 10—*Lepidocyclina samanica* n. sp. $\times 20$.

Fig. 11—*Lepidocyclina sectionensis* n. sp. $\times 20$.

Subgenus *HELICOLEPIDINA**Helicolepidina august-tobleri* W. Berry n.sp.

Fig. 1.

Test discoidal, equilateral, large, fairly thick, 3.74 mm. in diameter, 1.00 mm. thick, ratio of diameter to thickness 3.74:1. Test thins evenly from center to within about 0.333 mm. of periphery where it thins more slowly, producing a pronounced flange. Central boss 3.072 mm. in diameter. Surface papillated, small and evenly spaced, the papillae on the boss being slightly greater in diameter. Pillars polygonal in shape and 566.8 microns in diameter at the surface. The lateral chambers at the surface are 83.5 microns in diameter with walls 17 microns thick.

The nucleoconch is composed of one nearly circular chamber surrounded by eight inner primary spiral chambers (see Fig. 7.). The first circular chamber is 156 microns in diameter with walls 23.4 microns thick. The secondary spiral chambers are somewhat arcuate in shape, and make about $1\frac{1}{4}$ coils before reaching the periphery. The normal equatorial chambers are open-arcuate to hexagonal and average about 78 microns in radial diameter and 78 microns in tangential diameter with walls 15.6 microns thick.

Cotypes.—Collection of Willard Berry No. L-23.

Occurrence.—Talara shale, 958 feet above base; northwestern Peru.

H. august-tobleri resembles *H. spiralis* Tobler from the Priabonian of Trinidad and Venezuela in general aspect. In thin section it is easily recognized by having 8 primary spiral chambers and not 4 as in Tobler's species. It does not closely resemble the *Helicolepidina* mentioned from the Verdun grits of Peru. It is named in honor of the author of the subgenus; the late Dr. A. Tobler of Switzerland.

Genus *OPERCULINA**Operculina atascaderensis* W. Berry var. *samanica* W. Berry n.var.

Fig. 5.

Test medium to large, 3.67 mm. in diameter, and 0.80 mm. thick, ratio of diameter to thickness 4.5:1. Entire test about the same thickness. Surface ornamented by raised suture lines. The test starts with a well defined nucleoconch then makes 3 gradually increasing coils, the last coil containing 29 chambers. The septa are curved convexly outward. In the last two coils there are several septa which are compound or double on the inner end, and single on the outward end.

Cotypes.—Collection of Willard Berry No. O-7.

Occurrence.—Talara shale, 958 feet above base; northwestern Peru.

This variety is very close to *O. atascaderensis* from the Atascadero limestone (Saman conglomerate). It is probably a descendant of *O. atascaderensis* but differs from the parent in having the septa dividing near the outward and not the inner end. This variety is quite like *O. irregularis* Reuss described from Oberburg in Steiermark. It is easily recognized in thin section by the character of the dividing septa.

***Operculina talara* W. Berry n.sp.**

Fig. 8.

Test small, 1.58 mm. in diameter and 0.5 m. thick, ratio of diameter to thickness 3.16:1. Test much thicker at center than at periphery. Surface ornamented with raised suture lines. Test starts with poorly defined nucleoconch then makes about 3 very slowly increasing coils, the last coil containing about 22 chambers. The septa are slightly curved convexly outward except their outward ends where they are strongly bent backwards. The walls are very heavy often being about $\frac{1}{3}$ the height of the chambers in thickness and the septa about $\frac{1}{5}$ the width of the chambers in thickness.

Cotypes.—Collection of Willard Berry No. O-9.

Occurrence.—Talara shale, 958 feet above base; northwestern Peru.

O. talara seems to bear a slight resemblance to *O. vaughani* Cushman, described from the Ocala limestone and the Brito formation, in the number of coils and the number of chambers in the last coil. Otherwise they differ greatly. The new form is easily recognized by the extremely thick walls of the chambers.

***Operculina samanica* W. Berry n.sp.**

Fig. 2.

Test medium, 2.34 mm. in diameter and 0.40 mm. thick, ratio of diameter to thickness 5.68:1. Entire test about the same thickness. Surface smooth except for slightly raised suture lines. Test starts with a poorly defined nucleoconch, then makes about $3\frac{1}{2}$ gradually increasing coils, the last coil containing 28 chambers. The septa are curved convexly outward, the outer end often curving a little more sharply than the rest.

Cotypes.—Collection of Willard Berry No. O-8.

Occurrence.—Talara shale, 958 feet above base; northwestern Peru.

O. samanica might be confused with *O. peruwiana* W. Berry but it has a greater number of chambers in the last coil and the septa are much less curved and more regular.

ENTOMOLOGY.—*New genera and species of leafhoppers related to Scaphoideus*.¹ E. D. BALL, University of Arizona.

The writer in preparing a paper on the food plants, life histories and larval characters of the species of *Scaphoideus* was impressed with the fact that there were a number of groups included that were structurally distinct and in a number of cases had quite distinct food habits and ecological relationships. It appeared to be necessary, therefore, to recognize these groups, describe some new species and discuss some apparent synonymy before such a paper could be satisfactorily prepared.

¹ Received November 14, 1931.